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SURVEY OF LICHENS BIODIVERSITY IN DIFFERENT AREAS OF CSÓR VILLAGE, HUNGARY

Barbara KÖVICS, Hosam E.A.F. BAYOUMI HAMUDA*

Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary
E-mail: Bayoumi.hosam@uni-obuda.hu

Abstract: *The bioindication is an important agent today and in the future, as what could give a clearer picture of the atmosphere around us. Lichens play as bioindicator. Lichens do not tolerate the sulfur dioxide content of the air. This urban or industrial pollution is polluted air are often called "lichen deserts". So where the lichens absence, there is SO_2 in the air. For this purpose, 58pictures of lichens were taken in 4 different areas of Csór village: 1) Mátyás Király utca (street), 2) Hadi út (road), 3) Vízmű telep (Waterworks Plant), and 4) Dózsa György köz (interval).. Study areas were selected to include a wooded, green area, a less populated, not very busy area, and parts with more traffic in the village. First location was the garden of a family house, where most varieties of fruit trees are found are full with lichens. Second area was examined a small part of a wooded area were one or two or many lichen colonies are found. Third location was a part of the waterworks site is already a wooded area. The fourth area was the garden of another family house. There are no fruit trees in this area, only two pieces of ornamental trees. It was the first area where the lichens found on the fence. Based on the photos, morphology, colour, diameter, and extent of the lichens were examined. In addition, most dominant types were investigated. Lichens of different shapes and sizes in the four areas were examined. The investigations showed that mostly yellow and white leafy lichen are there. Yellow plate lichen and map lichen were also found. Exceptions are the third and fourth locations, where the yellow-leafed lichen outside the trunk of the tree on the stones on the side of the building and on the boards of the bench and fence. The sizes of the lichens are different. Their surface area is very varied. Because Csóron does not contain SO_2 in the air, lichens are present everywhere in an undamaged state. The most dominant species in the studied areas was the yellow-leafed lichen. Lichens are used to study global climate change, air quality. Attention must be paid to its use in the pharmaceutical industry due to its antibiotic and antiseptic effect.*

Keywords: *Lichens, air quality, distribution, Csór village, morphological investigation*

INTRODUCTION

Lichens were already known before our time and were probably used them. Several ancient written relics prove this, although it was not mentioned as lichen, but we can recognize different types of lichens from the description of the species. From later sources in which they are already mentioned and studied as lichens, we can see that these complex organisms have been used both in medicine (e.g. Icelandic lichen, bearded lichen) and in art (extracted dye) and many other fields. Lichens are one of the most peculiar groups in the living world. The word ―lichen‖ was termed by Theophrastus in 300 BC. It is a Greek word which means superficial growth on the bark of the trees. Lichen is a

combination of two organisms one is unicellular green alga and another one is fungus, sometimes in place of alga, cyanobacteria is also present (Stace, 1991). Alga and fungus helps each other in surviving, the algal part is known as photobiont as it contain photosynthetic pigment which provide food for the whole organism with the help of sunlight and other part is known as mycobiont this provides structural support to the organisms (Stace, 1991). There were lots of controversies about the relationship between alga and fungus. For the first time a Swiss botanist Schwendener in 1867 demonstrated the dual nature of lichen thallus after this there is a great discussion started on the nature of relation between the fungus and the algae. It was proposed that the nature is parasitism because of the haustarium of fungus enter in the algae and draw out nutrients for its growth, but later this theory was discarded because in parasitism the organism which is dominant kill the weaker one but in this case the algae does not die. Then this is called helostism because in helostism master and slave relationship is appears and in this case fungus is the master and the algae is slave, some scientists called it endosaprophytes because fungus is saprophyte (which feeds on dead and decade organisms) it is observed in some lichen thallus the algae is dead and the fungus feed on them (Stace, 1991).
Some lichenologist called the relationship mutualism in which both the organisms help each other without any harm and in lichen alga provide food and nutrition for growth and fungus provide protection and structural support to the whole organism, therefore relation is called symbiotic in which two organisms living together without killing each other (Ahmadjian, 1995). Lichen is very complicated organism, mostly it contains 90% of fungus and the remaining is the alga, this ratio can be varying from species to species. With the help of information technology and computer applications all the informative data which is collected during identification is compiled and stored in an application in the form of digital library through which one can easily retrieved the data for future use. This helps the taxonomists in identification, characterization and in quick classification of lichens (Singh et al., 2019).

Morphology: In morphology of the outer most surfaces was observed (Figure 1), the upper surface and the lower surface of lichen thallus were observed deeply under dissection microscope. The morphological characters are divided into two parts, characters of thallus and characters of fruiting bodies, firstly the thallus were grouped according to their growth forms (leprose, crustose, foliose, squamulose, dimorphic, fruiticose), thallus shape (irregular, circular), size, colour, texture (smooth, rough, warty), upper surface is observed for the presence of finger like projections (isidia), granular structure (soredia), fine powder (pruina), black dots (pycnidia) and whitish decorticated areas (pseudocyphellae).
The branching pattern length and breadth of marginal lobes, presence of hair like structure (cilia) has to be noted. The morphology of fruiting bodies has to be studied separately. In case of apothecia, shape (rounded or stretched), size, attachment (stalked or not) colour and texture of the margin and disc, shape of the disc (concave or convex) are observed. In case of perithecia its colour, shape, size and the position of its opening (ostiole, apical or lateral); single or grouped has to be noted. The lower surface of only foliose lichens can be seen as it is absent in crustose lichens. While dimorphic and fruticose lichens do not show dorsiventral differentiation. The colour of lower surface, presence of any pores (cyphaellae, pseudocyphellae), presence or absence of rihizines (root like structure) their colour, distribution, branching, abundance are to be noted.
Lichens are also observed inside a closed UV chamber at 254 and 365 nm to see whether the lichen has florescence characteristic (yellowish and bluish colour) or not because some lichens shows florescence due to the presence of substance called lichexanthone.



Figure (1): The vertical section of lichen thallus

Their bodies were formed by a symbiosis of fungal filaments and photosynthetic organisms. Over the millions of years, coexistence has resulted in such a close relationship between certain fungi and algae that they have become self-sustaining organisms with a specific body structure, specific metabolism. The concept of lichen has been most accurately described so far in the work of Hawksworth and Honegger, the most complex, complete formulation to date: ecologically obligatory, stable, mutualistic coexistence of the population of green algae and / or cyanobacterial cells, the photobionate. To date, approximately 650 compounds have been detected. The lichen material of some species is medicinal. Icelandic lichen is used in cough candy as herbal tea. There are also lichens that are suitable for textile dyeing. Today, lichen is also used by the perfume industry, and the lichen in it is used to preserve the scent. In addition, in some species, the lichen material acts as a UV filter or is responsible for the colour of the colony, such as in the yellow lichen. An interesting feature of lichens is that they are sensitive to increases in the SO_2 content of the air, i.e. they are narrowly tolerant to this environmental factor. They disappear from places where the air is polluted with SO_2. They are also called indicator organisms because their absence indicates high SO_2 content in the air. Air pollution is well illustrated by lichen maps made in big cities and around industrial estates.

Bioindicators are living things that somehow respond to changes in the environment. This may mean that they disappear or that more of some of their types appear in a particular area. With these we can examine the change of the environment, the degree of pollution. To study such processes, it is preferable to study living organisms in nature because all environmental changes can be detected in them, as they are most closely related to the environment. Advantage of bioindicator It is very good for monitoring the environment as they are closely related to nature. We can get a general picture of the area we are looking at. We can see the relationship of living beings to their habitat. This is a quick, very simple method. Disadvantage of bioindicator is that we cannot compare it to any standard here. There is no given method for how to examine a living thing.

Identification: Identifying lichens is much more difficult than identifying vascular plants. Each lichen thallus is a complete microscopic world with unique characteristics separating it from the other lichens. Lichens are classified based on the fungus and fungal features. When identifying lichens, keep in mind that one species of fungus can have two different forms if paired with two different "photobionts". It is not common but it does happen. In order to identify lichen to species, lichenologists use common household chemicals and some not-so-common chemicals to test the colour reaction of the unique compounds found in the structure of the lichen, as well as using a lichen key to distinguish between species. Although a few of the chemicals are common, such as bleach and iodine, others are not as easy to get and are costly and dangerous. However, just about anyone can use a botanical identification key and a hand lens to identify the genus of lichen and appreciate their collection. Even if you are not interested in identifying lichens, they are still interesting and amazing organisms to look at with the naked eye as well as under a hand lens or microscope. Realizing the roles lichens play in our environment will give you a greater appreciation of the world around you.

Types of lichens: Lichens are the organisms which grow in diverse condition and at all phytological regions of the world (Boustie and Grube, 2005). Their growth is very slow, they grow few millimetres or centimetres in a year (Table 1).
Types of lichens, differentiated on the basis of size, growth forms and substrate on which they grow.
Lichens are categorized in different types on the basis of their size, substrate in which they grow and on the basis of their growth forms.

Based on size: On the basis of size lichens are of two types: Microlichens and Macrolichens (Awasthi, 1988; 1991; 2007).

- **Microlichens:** These are the lichens which are small in size and are not easily defined because their physical characters cannot be seen easily without microscope by naked eyes.
- **Macrolichens:** These are the lichens which are well defined and can easily observe by naked eyes.

Table.1 Types of lichens

Based on size	1. Macrolichens
	2. Microlichens
Based on growth forms	1. Crustose
	2. Foliose
	3. Fruticose
Based on substrate on which they grow	1. Corticolous
	2. Ramicolous
	3. Legnicolous
	4. Saxicolous
	5. Musicolous
	6. Terricolous
	7. Follicolous

Based on growth forms: Lichens which are grow on bark of the trees are called corticolous, which grows on twigs called ramicolous, which grows on dead wood logs are called legnicolous, which grows on rock and boulders are called saxicolous, grows on moss called musicolous, grows on soil called terricolous and on evergreen leaves called follicolous. They are also growing under water but not only in water or in ice, they always required substrate for growth (Mishra *et al.,* 2016).

Based on substrate on which they grow: On the basis of physical appearance lichens are of three types.

- **Crustose:** These are the lichens in which thallus is closely attached to the substratum without leaving any free margin and it is very difficult to collect it. Most of the times these lichens are collected along with its substrate, in these lichens rihzines and the lower cortex is absent.
- **Foliose:** These are the lichens in which thallus is loosely attached to the substratum leaving free margins, they appears like a leaf and therefore also called leafy lichens.
- **Fruiticose:** These are the lichen in which the thallus is attached only at one point and the rest of the thallus growing hanging and erect like a fruit and therefore they are called fruiticose lichens.

Living spaces of lichens

1. **Epiphytic species**
   - bark dwellers (corticol)
   - branch dwellers (ramikol)
   - leaf dwellers (epifil)
2. **Terrestrial species**
   - rock dwellers (saxicol)
   - soil dwellers (terricol)
3. **Artificial grouping of lichens (External appearance)**
   - Bark-settled lichens: Writer's lichen, Map lichen
   - Leafy lichens: Yellow lichen, Lung lichen, Yellowish lichen
   - Bushy lichens: Bearded lichen, Oak lichen, Oak lichen, Reindeer lichen, Common funnel lichen

Importance of identification of lichens

Lichens has been used for many purposes in India as well as in all over the world because lichens have tremendous properties in them due to the presence of various natural compounds known as primary and secondary metabolites they have varied chemistry and produced many polyketide derived phenolic compounds such as depsides and depsidones which are not known to other group of plants (unique with respect to higher plants), therefore lichens are used for the preparation of natural dyes, crude drugs for medicines, perfumery, agrochemicals (Banerjee, 2002; Kumar and Upreti, 2008), also evaluate air quality, climate change, to detect accumulation of heavy metals. Lichens are the most significant indicators of air pollution and ecosystem health (Upreti and Pandev, 1994; Wolseley *et al.,*

1994; Upreti, 1995; Sloof, 1995; Mistry, 1998; Vokou *et al.,* 1999). Many lichens have economic applications, including uses in traditional medicines (Richardson, 1991; Gonzalez-Tejero *et al.,* 1995; Upreti and Negi, 1996), these properties makes lichens very popular among the scientists for future research, to take the benefit of these properties correct identification of lichens is necessary because these properties are specific for specific species. There are many properties which are not explored yet because of identification, which is very difficult task due to the complex structure of lichens which consumes lot of time. Lichens are very interesting organisms as they contain huge properties and most of them are left untouched. Exploration of these properties is only possible when lichens are identified correctly, properly, easily and on time.

Methods used for identification of lichens

Lichens contain two organisms together (alga and fungi), both the organisms have different species of alga and fungi in different ratio. Lichens are very sensitive to environment and geographical conditions therefore their properties are changed according to the environment in which they found due to this, clear and correct identification of lichens is very difficult, thus the taxonomist used different methods for the identification of lichens, these methods were used from so many years and are modified day by day to get more information or knowledge about lichens.

Three major approaches are used for the identification of lichens, Microscopic approaches are based on physical characters of lichens, Chemical approaches exploit the chemical compounds of lichens to identify them while advanced molecular approaches used to identifying lichens on the basis of their genetic make-up. There are different approaches of identifying the lichens are in Table (2).

Table (2): Methods used for identification of lichens

Microscopic Approaches	Morphology
	Anatomy
Chemical Approaches (chemotyping)	a) Colour spot test
	b) TLC
	c) HPTLC
	d) HPLC
Molecular Approaches	a) PCR genotyping
	b) DNA Barcoding

Relationship between lichens and sulfur dioxide

Since the mid-1800s, we have read studies from several countries that have shown that the disappearance of lichens is primarily caused by the appearance of SO^2. These are the first records in which SO_2 is blamed. There are many reasons why lichens disappear with such contamination. One such reason is that lichens absorb the amount of water and nutrients they need for life from the air and not from the soil. Due to their low chlorophyll content, their ability to recover is limited. Lichens do not have an outer protective layer that would prevent contaminants from entering the plant immediately, so these substances can easily enter all the way to the inside of the plant and accumulate these toxic substances within themselves. This can be solved by other plants by deciduous trees, but this does not occur in lichens, so the parts damaged by the toxic substance or anything else cannot be removed.

In this study, we examined the appearance and distribution of lichens in some areas of Csór village, by comparing the gardens of family houses and wooded areas. Lichens play an important role in nature and in people's lives. Their importance in biomonitoring, environmental protection and nature conservation increases their importance. Therefore, lichens are increasingly used to assess endangered natural habitats. Also, lichens are used for environmental impact assessments and are used to monitor disturbances in nature, especially those that have an exceptionally high and increasing number of chemical pollutants. Lichens are sensitive to air pollution but mostly to SO_2pollution.

Sulfur dioxide is found in the air in cities where industrial activities take place. Fortunately, Csór village is not found in this atmosphere. The settlement of lichens depends on the air quality, which is manifested in the fact that if the air quality improves, the lichens can settle back in that place. Also, the second aim of this study was to know how much of SO_2 in the Csór village atmosphere influences the

appearance of lichens. In addition to the photographs, we determined the different characteristics (location, type, etc.) and properties of the lichens found in the study areas. Morphologically, we wrote a type description of them and described in more detail the relationships between SO_2 and lichens.
Th is paper gives an account on the discovery of the lichen types in Csór village, Hungary. We provide data on population size and types of the Hungarian lichen flora.

MATERIALS AND METHODS

For the studying the distributions of lichens in some areas in the village Csór, Hungary, we used only the morphological approach and it was documented by the pictures of lichens in 4 different areas of Csór: 1) Mátyás Király utca (street), 2) Hadi út (road), 3) Vízmű telep (Waterworks Plant), and 4) Dózsa György köz (interval). We tried to select the areas to include a wooded, green area, a less populated, not very busy area, and parts with more traffic.
The first location was the garden of a family house, where most varieties of fruit trees are found. Pictures were taken for all of them in their entirety and then up close the lichens.
Second location, we examined a small part of a wooded area. Almost everywhere there were one or two or many lichen colonies.
The third location was very similar to the second. As this part of the waterworks site is already a wooded area.
The fourth location, we visited the garden of another family house. There are no fruit trees in the area, only two pieces of ornamental trees. It was the first place we found lichens on the fence. Based on the photos we took, we looked at the type, morphology, colour, diameter, and extent of the lichens to see how many lichens could be seen on each tree. In addition, we looked by area to see which type was the most dominant there.
At the end, we collected the information about the average of the annual data on SO_2 as atmospheric pollutant concentrations ($\mu g/m^3$) from the website of the National Environmental Information System (OKIR). Based on the extracted data, we made a diagram of the change in SO_2 concentration broken down by years. We then compared the data with the amount of lichens photographed that were found. Our aim is to examine the values issued by OKIR, whether they are correct, or whether we come to a different conclusion due to the amount of lichens in the areas.

RESULTS AND DISCUSSION

Plant biomonitoring of trace element air pollution, including the use of lichens, often is affected by local variation in specimen concentrations; this variation has been termed relative local uncertainty (RLU). These RLUs consist of variations that arise from biological and microclimatic variability, and from sample handling and analysis procedures (Wolterbeek and Bode, 1995). Relative local uncertainties affect biomonitoring programs because RLUs must be accounted for when comparing results between sample sites. If the differences in the results of the monitoring between the sample sites are not greater than the RLU they should not be considered biologically significant and should not be used to support a conclusion of different levels of air pollution.
Intensified field work and application of new techniques for studying the distribution of lichens in a local region, we obtained the following observations in the Csór village.
Lichen investigation in Csór village Beak
• Csór village is located (Figure 3) in Fejér county, in the Székesfehérvár district.
• Region: Central Transdanubia
• Its location. s. 47 ° 12 ′ 14 ″, k. h. 18 ° 15 ′ 25 ″
• It is located between Székesfehérvár and Várpalota cities. The border of Veszprém and Fejér counties is one kilometers away.
• It is surrounded by the Bakony in the north and Sárré in the south.
• Csór village has special water base and extremely high quality water (karst water).
• A karst spring from a hill next to the waterworks supplies water to Székesfehérvár and the local residents. But there are other springs that are slightly warm water.

Regarding to the distribution and appendence of lichens in the village, our results documented that we collect 58 pictures of different lichen specimens.

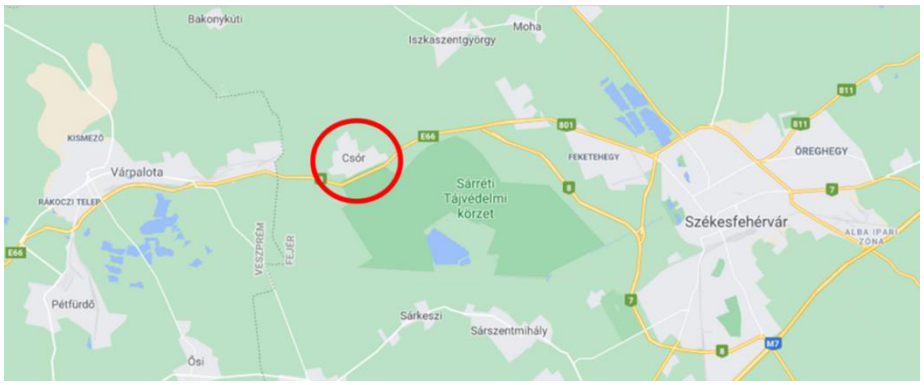


Figure (3) The Location of the Csór village

Observations and distributions of lichens in the first location



Figure (4): First examined area: 8041 Csór Mátyás Király utca (street) 23

The observations and collected specimens from the first location are shown in the Figures (5A-5G). In Figure (5), the observation of lichens in part A showed the yellow-leafed lichen and the white-leafed lichen can be found in several places on the tree. Their diameter: 2-5 cm. The most dominant is the yellow-leafed lichen.



Figure (5A) Observations of lichens in first location – part A

In Figure (5), the observation of lichens in part B showed that white and yellow leaf lichens and yellow plate lichens can be observed alternately on the pear tree. Their diameter: 2-6 cm. The most dominant is the white-leafed lichen.



Figure (5B) Observations of lichens in first location – part B

In Figure (5), the observation of lichens in part C showed that the white-leafed lichen and the yellow plate lichen can be observed alternately on the cherry tree. Length: 1-12 cm. The most dominant is the yellow plate lichen.



Figure (5C) Observations of lichens in first location – part C

In Figure (5), the observation of lichens in part D showed that the yellow and white plate of lichens can be found in several places on the walnut tree. In some places they form a whole colony. Diameter: 1-8cm. The most dominant is the yellow plate lichen.



Figure (5D) Observations of lichens in first location – part D

In Figure (5), the observation of lichens in part E showed that the white-leafed lichen is found to a greater extent on the vinegar tree. The surface of one or two branches is completely covered. Length: 1-30 cm. The most dominant is the white-leafed lichen.



Figure (5E) Observations of lichens in first location – part E

In Figure (5), the observation of lichens in part F and part G showed that there are also 3 different lichens on the cherry tree. Yellow plate lichen, white leaf lichen and yellow leaf lichen. Their diameter: 1-5 cm. The most dominant is the yellow-leafed lichen.



Figure (5F) Observations of lichens in first location – part F



Figure (5G) Observations of lichens in first location – part G

Observations and distributions of lichens in the second location

Figure (6) shows the location of the second collection area.



Figure (6): Second examined area: 8041 Csór Hadi út (Road)

It was found that four different species of lichens in the wooded area. They were mostly in a combination between yellow mixed with grey coloured lichens, and in somewhere you can find also slightly white lichens (Figures 7A- 7C). Those were the yellow and grey leaf lichens, are characterized by the yellow plate lichens, and the map lichens, respectively. The diameter of the yellow lichen is 2-5 cm. The most dominant was the yellow and map lichen shaped.



Figure (7A): Collections of the white, yellow and grey lichens on the branches of trees



Figure (7B): Collections of the yellow, yellowish-green and grey lichens on the branches of trees



Figure (7C): Collections of the yellow, yellowish-green and grey lichens on the branches of trees

Observations and distributions of lichens in the third location

Figure (8) shows the location of the third collection area.

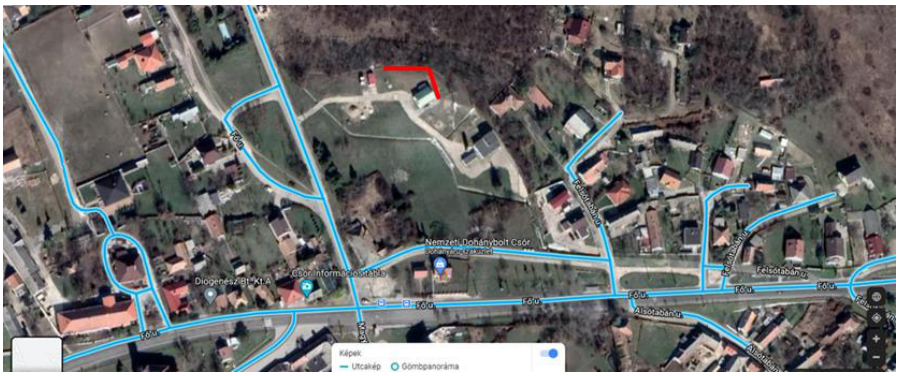


Figure (8): Third examined area: 8041 Csór Waterworks

During the observation and collection of lichen specimens, it was the first place that we found lichens growth on a rock. In addition to the many small yellow and greenish-yellow lichens, we also found yellow plate lichens. These observations can be shown in Figures (9A – 9D).



Figure (9A): Lichens collections. Growth of lichens on the rock surfaces from the third examined area: 8041 Csór Waterworks

It was found that the first tree where it was photographed is related to white map lichen group instead of yellow lichen. The second picture was taken of a broken tree branch. It has yellow and white leafy lichens on it. Their edges are curled (Figure 9B).



Figure (9B): Lichens collections from the third examined area: 8041 Csór Waterworks Plant

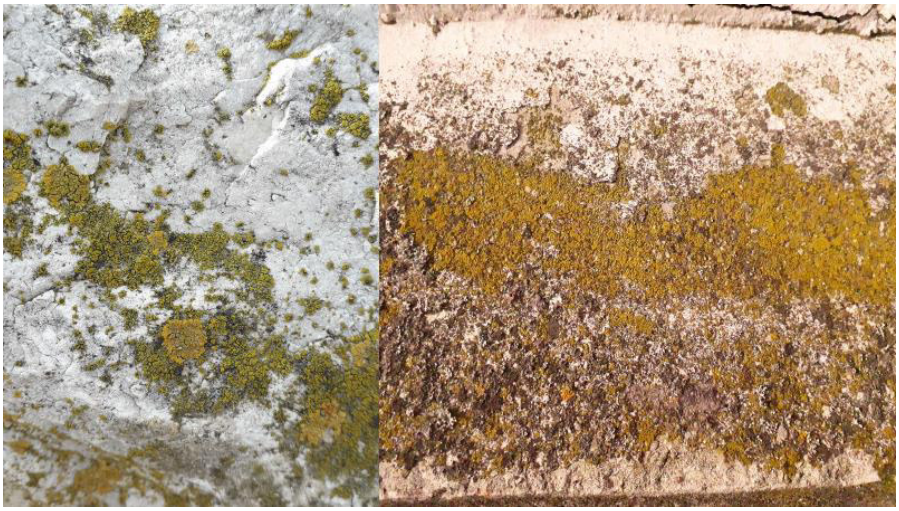


Figure (9C): Lichens collections from the third examined area: 8041 Csór Waterworks



Figure (9D): Lichens collections from the third examined area: 8041 Csór Waterworks

Observations and distributions of lichens in the fourth location

Figure (10) shows the location of the fourth collection area.



Figure (10): Fourth examined area: 8041 Csór Dózsa György köz (interval) 5

On the bench of a tree, many colonisations of lichens can be found, yellow, small grey and white leaf lichens alternated. The observation could be documented by photograph yellow-leafed lichens on the planks of the fence. The most dominant was the yellow-leafed lichen (Figures 11A and 11B)..



Figure (11A): Lichens collections from the fourth examined area

There is only one tree in the fourth study area. The observation showed that the truck of the tree has yellow plate lichen on one side and white and yellow leaf lichen on the other side. The most dominant: yellow plate lichen.



Figure (11B): Lichens collections from the fourth examined area



Figure (11C): Lichens collections from the fourth examined area



Figure (11D): Lichens collections from the fourth examined area

General characterization of leaf, plate, map lichen (Yellow and white leaf lichen)

- Golden-yellow, whitish at the bottom, with erect-edged colonies frillate, lobed, rosette-shaped, broad, flat, wrinkled, almost concave.
- Extremely rich in form.
- Its colonies are mostly circular.
- Found on both bark and calcareous rocks.
- Nitrophilic (nitrogen-loving) along cities.
- Tolerates air pollution well.
- Their batteries lie loosely on the socket and can be easily detached.
- The substrate can be: rock, bark, soil.

Yellowish lichen

- The battery is greenish or straw yellow.
- Older or damaged parts are greyish-green or greenish-black, fragmented.
- The size of the palm-sized, circular, cross-wrinkled, thick colonies of rounded lobes.
- The back is black with a glowing stripe on the edge.
- Lives on deciduous, rarely coniferous trees or mossy rocks.
- Damaged specimens are found in air-contaminated areas.

Map lichen

- Its colonies of greenish-yellow fields are located in a sub-colony.
- Its square, black apothecia (apothecium = cup-shaped fruiting body of some fungi and lichens with concave hoses at the top) show a map-like pattern.
- It forms mostly on silicate rocks.
- The substrate can be: rock, bark, anthropogenic substrate.
- Some species live inside the bark.
- The battery may be cohesive, cracked, granular, warty, lined.

Sulfur dioxide

- SO_2 is a toxic, colourless gas with a typical odour.
- Converts to sulfuric acid on contact with water.
- Main cause of acid rain.
- SO_2 has natural and anthropogenic sources.
- Natural sources include pollution from oceans, forest fires, and volcanoes.
- Anthropogenic sources can be coal and oil burned in power plants and households, but metallurgy, sulfuric acid production and elemental sulfur processing also play an important role.

Physiological effects

- SO_2 is harmful to humans and animals if inhaled.
- When adsorbed on wet airway mucosa, it is irritating due to its acidic pH.
- Once in the bloodstream, it converts hemoglobin to sulfhemoglobin, inhibiting oxygen uptake. In clean air, the blood count is restored.
- Acute irritation of the nose, throat and lungs, may cause coughing, discharge and asthma attacks.
- At free atmospheric concentrations, these do not occur.
- In chronic cases, SO_2 respiratory diseases e.g. can cause bronchitis.

Effects on the ecosystem

- SO_2 forms sulfuric acid, sulfuric acid with the humidity of the air, which damages the living world.
- The main component of acid rain, which damages trees and can destroy entire forests.
- Lichens show the presence of SO_2 as a bioindicator because they do not develop in its presence.
- It can be established that there is no SO_2 in the atmosphere in Csór village (Figure 12). Since 2013 up to 2019, the concentrations of SO_2 in the village were zero, because there is, no industrial works are carried out in the village.
- This is also due to the high quality of the air. This is also due to the ubiquitous lichens. The concentrations of SO_2 in the atmosphere in the Csór village during 2020 and 2021 were not determined.

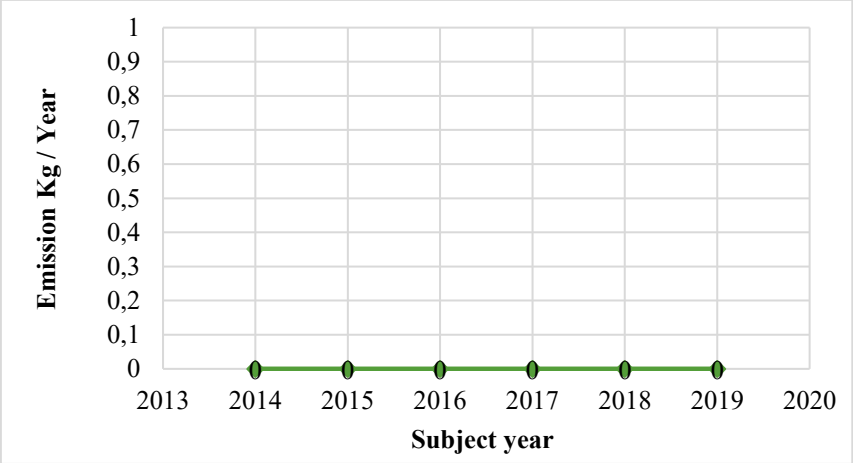


Figure (12): Atmospheric content of SO_2 in Csór village, Hungary

According to recent estimations, lichens comprise about 18 500 species (Boustie and Grube, 2005; Feuerer and Hawksworth, 2007). Since 1983, the name of lichen refers to its mycobiont (Voss et al., 1983). The fungal partners are mostly (98%) Ascomycota (Gilbert, 2000; Honegger, 1991) and the others belong to the Basidiomycota and anamorphic fungi.
Approximately 21% of all fungi are able to act as a mycobiont (Honegger, 1991), thus lichens form the largest mutualistic group among fungi. Only 40 genera are involved as photosynthetic partners in

lichen formation: 25 algae and 15 cyanobacteria (Kirk et al., 2008). The photobionts in approximately 98% of lichens are not known at the species level (Honegger, 2001) Lichens are able to survive in extreme environmental conditions; they can adapt to extreme temperatures, drought, inundation, salinity, high concentrations of air pollutants, and nutrient-poor, highly nitrified environments (Nash, 2008), and they are the first colonizers of terrestrial habitats (pioneers). In addition, both fungal and algal cells in the lichen thallus are known for their ability to survive in space (Sancho et al., 2007). Interactions between the symbiotic partners partially explain this spectacular success of lichens in unusual environments (Backo and Fahselt, 2008). Nevertheless, many lichens are very sensitive to various air pollutants, especially nitrogen-, sulfur- and heavy metal-based compounds; therefore they are widely used as bioindicators (e.g., Fernández-Salegui et al., 2007; Glavich and Geiser, 2008; Sheppard et al., 2007). Xanthoparmelia mougeotii is a usnic acid containing, small foliose, sorediate, parmelioid lichen species with a pantemperate distribution. In Europe it occurs in most countries especially in cool, humid, "suboceanic" habitats, mainly on acidic rocks, and rather sporadic in the continental areas, e.g. isolated populations in Slovakia (near Strečno) or in Ukraine (Crimea). Recently another isolated Central European population was discovered in the Zemplen Mts (NE Hungary), approx. 200 km far from the Slovak population (Matus, et al., 2017). Lichens have been used in many areas, are used today and will continue to benefit many in the future. They used to be used for paint making as well: they got the so-called French purple with which silk and wool were dyed red, but the dye was not lightfast. In Egypt, lichens have also been used in the preparation of mummies, probably due to their antibiotic effect. Nowadays, the lichen research observed for surveying nature is becoming more and more widespread. Lichens are used to study global climate change, air quality, and biodiversity. Attention must be paid to its use in the pharmaceutical industry due to its antibiotic and antiseptic effect.

SUMMARY

Pollution of the environment is a very big problem today, although there are instruments that can be used to measure the amount of pollutants, it still does not provide an accurate answer to how the organisms present in the environment react with pollutants. Therefore, bioindication, especially with organisms in cities, will be important in the future, as what could give a clearer picture of the world around us than these living things. At the beginning of the documentation, as we mentioned, lichens also play a bioindicator role. Lichens do not tolerate the SO_2 content of the air if less than the limit value. This urban or industrial pollution is deadly to them, which is why cities with polluted air are often called "lichen deserts". So where the lichens became extinct, there is SO_2 in the air. For the examinations required for this investigation, authors took pictures of lichens in four different areas of Csór village (Mátyás Király utca ((street), Hadi út (road), Vízmű telep (Waterworks Plant), Dózsa György köz (interval)), and made a total of 58 pictures of the collected lichen specimens. authors tried to select the areas to include a wooded, green area, a less populated, not very busy area, and parts with more traffic. The first location was the garden of a family house, where most varieties of fruit trees are found. Authors photographed all of them in their entirety and then up close the lichens. Second area, authors examined a small portion of a wooded area. Almost everywhere there were one or two or many lichen colonies. In the third location, it was very similar to the second. As this part of the waterworks plant is already a wooded area. The fourth location, we visited the garden of another family house. There are no fruit trees in the area, only two pieces of ornamental trees. It was the first place we found lichens on the fence. Based on the photos we took, authors looked at the type, morphology, colour, diameter, and extent of the lichens to see how many lichens could be seen on each tree. In addition, authors looked by area to see which type was the most dominant there. Authors saw lichens of different shapes and sizes in the four areas examined. Mostly yellow, grey and white leafy lichen; we photographed yellow plate lichen and map lichen. Authors found lichens on tree trunks as well as on broken tree branches. The third and fourth locations are exceptions, where we found the yellow-leafed lichen outside the trunk of the tree on the stones on the side of the building and on the boards of the bench and fence. The sizes of the lichens are different. They were very small and there were also nice adult specimens. Their surface area is very varied. Because the atmosphere of

Csór village does not contain SO_2 in the air, lichens are present everywhere in an undamaged state. In our opinion, the most dominant species in the studied areas was the yellow-leafed lichen.

CONCLUSIONS AND RECOMMENDATIONS

Lichen biomonitoring using in situ specimens for air quality analysis requires sampling controls to minimize within–site variability. By uploading the pictures of the lichen specimens in this application, and comparing with the atmospheric air composition, results almost all the possible and nearest out comes (all about the lichens- photos, their classification and other information). This kind of approach should also be used for lichens to overcome the expense and consumption of time in identification of lichens. All the valuable data of the collected lichen samples can also be stored in the form of digital library and applications such as ―picture this‖ can be created and easily used by a person to get information about any lichen simply by clicking the photo of unknown one. Finally, this one can retrieve the sequence from database for future research.

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